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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
BAREFORD, KATHERINE A	
ART UNIT	PAPER NUMBER
1762	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	12/19/2006	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/501,267	ARAM, MEHDI	
	Examiner	Art Unit	
	Katherine A. Bareford	1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 October 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7-13 and 26-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Claims 6, 14-25 and 29-30 are canceled

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

The amendment of October 25, 2006 has been received and entered. With the amendment, claims 6, 14-25 and 29-30 have been canceled, and claims 1-5, 7-13 and 26-28 are pending for examination.

Election/Restrictions

1. The Examiner notes that claim 30, withdrawn from consideration as being directed to a non-elected invention by the Office Action of June 26, 2006, has been canceled.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1, 4, 5, 7-9 and 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over McCormick (US 4024617) in view of Ogden (US 3066042), Japan 2000-017418 (hereinafter '418) and Prasse (US 3617349)..

McCormick teaches a method of applying a wear resistant coating material to a surface of a piston ring. Column 1, lines 35-45, column 3, lines 35-40 and column 4, lines 5-30. The method includes application of the coating material by a thermal spray

process, such as plasma spraying or oxy-acetylene flame. Column 4, lines 5-30. The applied coating material is heat treated at an elevated temperature and for a time effective to at least partially diffuse the coating material into the underlying surface by exposing the material to a heating temperature. Column 4, lines 35-60. The temperature range is such that a plasticizing element or constituent of the coating becomes sufficiently plastic to effect diffusion bonding at the interface of the coating and surface. Column 4, lines 55-60.

Claim 4: the heating is provided by induction. Column 4, lines 35-60.

Claim 9: the coating material can be a powder (pulverulent). Column 5, lines 29-35.

Claim 12: the coating material can contain alumina (aluminum oxide). Column 6, lines 60-65.

Claim 13: the coating material can be a cermet. Column 5, lines 29-35.

McCormick teaches all the features of these claims except (1) that multiple layers are put down with a heating diffusion treatment after each layer is applied, (2) the porosity of the resulting piston ring and its layers, (3) the even porosity and open pores (claim 5, 7), (4) the layer thickness (claim 8), (5) the heat treatment resulting in necks (claim 11).

However, Ogden teaches applying layers by spraying molten metal and subsequent heat treatment to diffuse the applied coating layer. Column 2, lines 10-60. Multiple thin layers are applied and respective following heat treatments are performed

until the desired thickness of the coating is achieved. Column 2, lines 10-60. For example, each layer can be 0.003 inches (0.076 mm) thick and the operation repeated four times until a thickness of 0.012 inches results. Column 2, lines 50-60. Ogden teaches that this method gives better results then to spray a single thick coating and heat treating, by improving diffusion and providing a stronger mechanical and metallurgical bond. Column 2, lines 40-45.

'418 teaches to apply an antifriction wear resistant coating to a bearing base material. See the abstract and paragraph [0008]. A metal layer is applied to a substrate bearing face of the bearing base material by a thermal spraying method. See the abstract and paragraph [0009]. Then a diffusion heat treatment is applied at a temperature equal to or below the melting point. See the abstract. This diffuses the coating into the substrate material. See the abstract. Prior to the heat treatment the coating has a porosity of 20 percent or less. See the abstract and paragraphs [0009]—[0010]. After the heat treatment the coating is hardened and has a porosity that has decreased to less than 10 percent. See the abstract and paragraph [0010]. However, porosity still remains after the heat treatment. See paragraphs [0052]—[0053]. The final porosity can vary depending on the conditions. See paragraphs [0049] and [0053].

Prasse teaches coating piston rings with a hard porous metal or alloy. Column 1, lines 45-55. Prasse teaches that the coating can be by thermal spraying, such as plasma spraying. Column 6, lines 10-50. The spray applied coating desirably has an open

porosity of 7-20 percent to allow inclusion of an anti-friction agent in the pores. Column 2, lines 55-70.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify McCormick to apply multiple layers of coating with a heating diffusion treatment after each layer is applied as suggested by Ogden with an expectation of desirable diffusion and bonding results, because McCormick teaches applying a coating to a piston ring and performing diffusion heat treatment after coating, and Ogden teaches that when applying a coating and performing diffusion heat treatment after coating, it is desirable to apply the coating as multiple layers with heating diffusion treatment after each layer is applied in order to provide better diffusion and bonding results. As to the temperature used, it would vary based on the coating material used, but McCormick suggests to perform routine experimentation to optimize the temperature by teaching to use a temperature range such that a plasticizing element or constituent of the coating becomes sufficiently plastic to effect diffusion bonding at the interface of the coating and surface. It further would have been obvious to one of ordinary skill in the art to modify McCormick in view of Ogden to optimize the porosity to be provided for the piston ring through the diffusion treatment to, for example, an open porosity 7 percent as suggested by '418 and Prasse so as to provide a desirable coated piston ring, because McCormick in view of Ogden teach to perform diffusion heat treatment, with Ogden indicating that such treatment reduces porosity, and '418 teaches that when performing diffusion heat treatments on

layers used as antifriction bearing surfaces, diffusion heat treatment can be used to reduce the porosity of thermal sprayed coatings to less than 10 percent, for example, to 1.5 percent and Prasse teaches that when thermal spray coating a piston ring with a coating, a desirable final porosity is an open porosity of seven percent. As to the evenly distributed porosity, this would be an inherent result of applying the thin layers and have the porosity reducing treatment on each layer. As to the layer thickness, Odgen teaches that a desirable individual layer thickness is 0.003 in (0.076 mm). As to the heat treatment resulting in necks, it is the Examiner's position that this would be an inherent result of performing the suggested diffusion heat treatment.

4. Claims 2, 3, 10 and 26-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over McCormick in view of Ogden, '418 and Prasse as applied to claims 1, 4, 5, 7-9 and 11-13 above, and further in view of Rastegar et al (US 5713129).

McCormick in view of Ogden, '418 and Prasse teach all the features of these claims except (1) the relative movement between thermal spray device and heat treatment device and the piston ring (claim 2), (2) the rotation about the axis (claim 3, 26), (3) the wire like form of the coating (claim 10).

However, Rastegar teaches applying a thermal spray coating to a piston ring. Column 2, lines 45-55. The method includes rotating a plurality of piston rings about a central axis and spraying a molten material on the outer surface of the piston rings. Figure 1, column 4, lines 5-30 and column 8, lines 25-30. The thermal spray device is

thus positioned so that there is relative movement between thermal spray device and the rotating piston rings. Figure 1, column 4, lines 5-30 and column 8, lines 25-30. The thermal spray device can be a high velocity oxy fuel gun (a form of flame spraying). Column 4, lines 5-30. The spray device can be used with either stock (wire) or powder coatings. Column 4, lines 5-30. During the spraying process the spraying apparatus traverses parallel to the longitudinal axis of the rotating piston rings. Column 8, lines 25-30. Multiple passes (that is, layer applications) are used to provide the final thickness of the coating. Column 8, lines 25-30. Rastegar further teaches that a cooling device 18 can be placed facing the piston rings such that cooling air can be applied to the rings after coating. Figure 1, column 4,lines 30-40 and column 8, lines 30-40.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify McCormick in view of Ogden, '418 and Prasse to provide the relative movement between the piston ring and thermal spray device/heat treatment device with rotation of the piston ring about it's axis and the use of powder or wire coating material as suggested by Rastegar in order to provide a desirable and efficient application method, because McCormick in view of Ogden, '418 and Prasse teach thermal spray application of a coating on piston rings, and Rastegar teaches that a desirable method of thermal spraying piston rings involves using powder or wire coating material fed to a thermal spray device which moves relative to the piston ring while the piston ring is rotated about its axis so that multiple layers of coating material are applied until the final coating thickness is reached. It further would have been

obvious to place the heat treatment device relative to the piston rings in a similar fashion to the thermal spray device for immediate treatment as each layer is formed in order to provide for efficient coating, because Rastegar shows that it is known to place another treatment device for post treatment of the coating (in that case, a cooling device to be used after all coating is done), and Ogden teaches the desire to heat treat each layer before formation of the next one.

Response to Arguments

5. Applicant's arguments filed October 25, 2006 have been fully considered but they are not persuasive.

Applicant argues that McCormick does not disclose applying more than one layer of the same material on the substrate with a heating diffusion treatment after heat layer is applied, or that the applied layer has any particular porosity. According to applicant, while McCormick discloses that the piston seals can have more than one layer, the layers are of different material, and this would have led one of ordinary skill in the art away from the claimed method, which comprises applying a plurality of layers of the same material. The Examiner disagrees. While McCormick teaches that piston seals can have more than one layer of different materials, or shows a piston with a layer of one material, the Examiner has used the further references to Ogden, '418 and Prasse to provide the suggestion that the instead of using a thick layer of an individual material, that "layer" should be applied as a series of thin layers with heat treatment for

diffusion between the layers. McCormick does not teach away from this process, because the use of multiple layers of different materials shows that there is no problem in applying multiple layers as part of the coating process, with Ogden specifically showing the benefits of using multiple thin layers of the same material as discussed above.

Applicant argues that Ogden does not disclose the application to a piston ring surface and eliminates pores. Applicant argues that Ogden does not suggest modifying McCormick's single layers coating to result in the claimed piston ring coating including multiple layers and having a porosity between 1 and 15 volume percent, rather Ogden teaches away from forming a porous coating layer. The Examiner disagrees. Ogden teaches the benefits of applying multiple thin layers with heat treatment diffusing in between the application of each layer over one thick layer with heat treatment diffusing afterwards -- that improved diffusion and a stronger mechanical and metallurgical bond occurs. One of ordinary skill in the art would expect this benefit to occur with various coating materials, not just platinum onto molybdenum, because it is a physical process that occurs. As to the porosity to be provided, since Ogden does not teach the features required or desired for piston rings, the Examiner has further cited '418 as to the specific expectations as to how each heat treating diffusion process would work with a coating applied to bearing surfaces (Prasse demonstrates that piston rings are a known form of bearing surface as discussed further in the paragraph below), including the amount of porosity that would be provided by one of ordinary skill in the art.

Ogden's teaching of the amount of porosity desired when coating other structures would not teach away from the adapting of the process for the specific porosity requirements of piston ring coatings given the teaching of '418 as to what would be expected by one of ordinary skill in the art.

As to '418, applicant argues that it applies to a bearing face of a bearing base material, and does not suggest the method of coating multiple layers with a heat diffusion treatment between each layer and the recited porosity of the applied plurality of layers. The Examiner disagrees. '418 teaches the coating of antifriction wear resistant coatings to bearing base materials. As discussed in Prasse, piston rings are a bearing base material with a "bearing face" that is to be coated antifriction wear resistant materials (see column 1, lines 5-10 and 35-60). Thus, the teaching of '418 as to antifriction wear resistant coatings on bearing base materials encompasses the desire for such coatings on piston rings. Prasse further demonstrates the overlapping porosity desire for coatings on piston rings. While '418 does not teach applying multiple layers with heat treating between each layer, it demonstrates the heat treatment and final porosity results and desires for a single layer, which would be repeated (as suggested by Ogden) for each successive layer.

As to Prasse, applicant argues that it does not teach or suggest the deficiencies of the other references and does not teach the porosity after heat treatment. The Examiner disagrees. The other references are not deficient in what they teach as discussed in the paragraph above. Furthermore, while Prasse does not show heat treatment to get

porosity in the desired range, '418 shows that heat treatment can be used to get the porosity in the desired range.

As to the combination of references, as discussed with regard to each reference above, it is the combination of references that provides the suggestion of the claimed invention, with the benefits of the use of the references provided as in the rejection above. No reference teaches against the combination for the purposes used as discussed above.

As to the argument that one skilled in the art of piston rings would not look to the bearing art technology, the Examiner disagrees. As discussed above, in regard to Prasse, that reference specifically provides that piston rings would be a form of bearing surface that needs to have a antifriction wear resistant coating.

As to the argument as to claims 2, 3, 10 and 26-28 that Rastegar further does not cure the above-discussed deficiencies of the other applied references, the Examiner disagrees. As fully discussed in the paragraphs above, the other cited references are not deficient.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Katherine A. Bareford whose telephone number is (571) 272-1413. The examiner can normally be reached on M-F(6:00-3:30) with the First Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone numbers for the organization where this application or proceeding is assigned are (571) 273-8300 for regular communications and for After Final communications.

Other inquiries can be directed to the Tech Center 1700 telephone number at (571) 272-1700.

Furthermore, information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

KATHERINE BAREFORD
PRIMARY EXAMINER